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THE STRIPED PEACH WORM.[1]

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INTRODUCTION.

The striped peach worm (*Gelechia confusella* Cham.), although described in 1875, has received little notice as an economic species. The larvæ feed in conspicuous webs on the foliage of the peach and on sand cherry (*Prunus pumila*) in smaller but more compact webs. While at present this insect is not a major pest on peach, the larvæ have been observed feeding on sand cherry in such numbers as to web nearly every terminal, partially defoliating the host plant, and this shows the latent possibility of extensive injury to peach orchards.

Under the direction of Dr. A. L. Quaintance, Entomologist in Charge of Deciduous Fruit Insect Investigations, the writer studied the biology and habits of the insect during the seasons of 1915 and 1916. The biological data secured, together with descriptions of all the stages and suggestions for control, are recorded in this paper.

[1] The writer is indebted to the following members of the Bureau of Entomology staff: To E. H. Siegler for the photograph used in Plate I, figure 1; to H. K. Plank for Plate II, figure 1, and Plate III, figures 1, 2, and 3; to J. H. Paine for Plate II, figures 2 and 3, and to F. L. Simanton for determining the place of oviposition on sand cherry and for conducting the spraying work in connection with the remedial measures.

The life-history studies were started at Benton Harbor, Mich., in 1915 and completed in 1916.

Adults were reared separately from larvæ collected on the two host plants and were identified as *Gelechia confusella*, by Mr. August Busck, of the Bureau of Entomology.

HISTORY.

The adult of *Gelechia confusella* was first described by Chambers (1)[1] in 1875, but with no mention of the source of his material. Pettit (4), under the heading "A new peach worm," writes as follows:

> A number of worms working in peach leaves were received from Mr. T. D. Atkinson, of Holland, Mich., on September 17. They were lepidopterous larvæ and were said to be very troublesome. The same species was received on July 3, 1899, from Monroe, Mich. One or two complaints were made from other places, though no specimens were sent.

These are apparently the only published accounts of the occurrence of this insect.

SYNONYMY.

In 1899 Pettit (4) described the larva of this insect and figured the larva and pupa, designating them "Peach leaf-binder, *Depressaria persicaeella* Murt." In the same publication (5) the adult is described as *Depressaria persicaeella* by Miss Mary E. Murtfeldt, of Kirkwood, Mo., from material sent her by Mr. Pettit. Miss Murtfeldt (6) changes *Depressaria persicaeella* Murt., to Gelechia.

Dyar (7) lists *Gelechia confusella* Cham., with *persicaeella* Murt. as a synonym. Busck (8) lists *Gelechia confusella* Cham. with synonyms *Depressaria persicaeella* Murt. and *Gelechia persicaeella* Murt., and makes the following note:

> Cotypes of Miss Murtfeldt's species are in the United States National Museum under type No. 4697. The species is very close to the foregoing, and I have no doubt is the same as Chambers's *Gelechia confusella*, the type of which is lost but the description of which tallies in every detail with the peach feeder.

In 1904 Pettit (9), under the name "The striped peach-worm (*Gelechia confusella*)," copied part of his former description and reproduced the figures of the larva and pupa of 1899, designating them as the "striped peach-worm." The synonymy stands:

Gelechia confusella Cham., 1875.
Depressaria persicaeella Murt., 1899.
Gelechia persicaeella Murt., 1900.

The writer has accepted the name "striped peach worm," as it seems to distinguish this insect from all other peach feeders and briefly describes the larva, which is the only stage commonly seen.

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[1] Reference is made by number to "Literature cited," p. 14.

FOOD PLANTS.

Previously published notes have recorded *G. confusella* as feeding only on peach foliage. During July, 1915, the writer observed a webbed condition on sand cherry (*Prunus pumila*) (Pl. IV) which resembled somewhat the injury already noted on peach (Pl. I), though the webs were more tightly bound and less silk was observable. The injury was so extensive and uniform over a sand-cherry thicket of about 15 acres in extent at this place near St. Joseph, Mich., that it seems probable that this is the native host plant of the insect.

FEEDING HABITS OF THE LARVA.

The larva feed either singly or gregariously on both host plants, and, though not voracious feeders, by their well-developed webbing habit include in their webs much foliage that is not used as food. The larvæ begin webbing directly after hatching, even before they feed, and usually spin the first thin white web on the underside of the leaves next to the midrib. They begin feeding next to the midribs of the leaves, first eating small irregular holes through the parenchyma and later skeletonizing either or both leaf surfaces.

CHARACTER OF INJURY ON PEACH.

The injury to the peach is caused by the feeding of the larvæ on the foliage. The webs spun by the larvæ are loose, with considerable silk showing, and are often very conspicuous. The leaves soon become dry and cease to function, when included in the webs.

CHARACTER OF INJURY ON SAND CHERRY.

The webs on the sand cherry are small and compact, with only a little silk showing, but in the fall the infested terminals and branches become prematurely brown and conspicuous. Feeding is confined to the foliage, and, although in rare instances the webs are constructed about fruit, in no cases have larvæ been observed to feed on the fruit. Larvæ of varying sizes are found in the same webs, indicating the probability of repeated oviposition in the same terminal. From 2 to 12 larvæ are usually found in the webs on the separate terminals, although the number is sometimes as high as 30. In most cases observed when there was only one web on a branch it was located at the terminal, but when more than one was present the webs started from the base as well as from the terminal. As the larvæ enlarge the webs, they extend them along the branches, gradually including more and more foliage.

DESCRIPTION.

THE ADULT.

(Pl. III, fig. 3.)

Because of its completeness the description of the adult is copied from Murtfeldt:

Antennæ dark fuscous, indistinctly pectinate and banded on the under side with pale buff. Palpi long, exceeding the vertex. Basal joint short, pale; second joint one-third longer than apical. Brush quite dense, distinctly divided, dark fuscous overlaid with cream-coloured scales, palest on inner side. Apical joint dark, very slender, with extreme tip cream white, most conspicuously so in ♂. Tongue long, sparsely scaled. Vertex dark brown. Face cream white. Thorax and tegulæ purplish-brown. Fore wings almost black, with rich purplish gloss, and sparsely sprinkled with white scales. On the costa back of the apex is a small, irregularly triangular, cream white spot, and a few scattered scales of the same colour form an obscure outer border. In the cell near its upper margin are two somewhat indefinite, cream-coloured dots in line, with a third one below and slightly back of the one nearest the base. Cilia fuscous, shading outward to gray. Lower wings shining silky, cinereous, almost silvery. Abdomen pale brown, terminal segment banded with buff at posterior margin. Lateral tufts buff, inconspicuous; anal tuft reddish-brown. Under surface speckled with brown and cream. Legs brown, annulate with cream white at the joints and middle of the tibiæ. Alar expanse from 16 to 17 mm.

THE EGG.

(Pl. II, fig. 3.)

The egg is bluntly elliptical, somewhat flattened at the smaller attached end; length, 0.57 mm.; greatest width, 0.42 mm. The color is clear white when newly deposited, changing within 24 hours to a creamy yellow, the surface smooth and shiny without markings. About 24 hours before hatching the eggs change to a pearl gray color.

THE LARVA.

(Pl. II, fig. 1.)

The newly hatched larva is about 1.5 mm. in length and is yellowish white in color, with head and thoracic shield fuscous. The reddish brown stripes are discernible after about 9 days and as they develop they give color to the larva. A detailed description of the full-grown larva is copied from Pettit:

The larva, when full grown, is three-eighths of an inch in length and quite slender. Its color is dirty yellowish-white with back and sides marked by six reddish-brown longitudinal stripes all of which extend the entire length from the thoracic shield to the caudal extremity except the pair on the dorsum which unite on the last segment and terminate there. Last segment bordered caudally with fuscous and base of anal pro-legs colored the same. Venter marked along the middle with a stripe like those on dorsum and sides,

which are about equidistant from each other and of about the same width as the spaces between them, color reddish-brown. Some of the spaces (yellowish-white) have dark points in them. Head and thoracic shield yellowish-brown, feet fuscous and dirty yellow. Four pairs of pro-legs beside anal pair which are of the same color as the ground color of the body. Base of anal pair black.

Mature larvæ (Pl. II, fig. 1) were found to vary from three-eighths to five-eighths inch in length, and in color to vary from yellowish white with poorly defined stripes to a clear white with vivid venetian-red stripes. There is an anteriorly directed semicircular black patch over each ocellar area.

THE PUPA.

(Pl. III, fig. 1.)

The pupa is unusually broad across the thoracic region, slightly flattened dorso-ventrally and quite variable in size. The average dimensions of 10 were found to be 6.3 mm. by 2.6 mm. When newly formed, the pupa is a light brown, changing later to a dark brown, the head, thorax, and ventral region obtaining a much darker color than the other regions. The wing pads are long, extending to cover all but the 3 posterior segments of the abdomen.

THE COCOON.

(Pl. III, fig. 2.)

This species differs from many of the genus in that it pupates normally in the soil. The larva enters the soil to a depth of about one-half inch and spins a white silken cocoon, which it incloses in fine soil particles and to the outside attaches coarser particles. Within this cocoon the larva pupates. The average size of 38 cocoons measured was 9.3 mm. in length by 4.4 mm. at the greatest width, slightly flattened to conform to the pupæ and usually distinctly curved.

SEASONAL HISTORY AND HABITS.

The following seasonal-history records were started at Benton Harbor, Mich., during the season of 1915 and were completed in 1916, in open-air insectaries in which glass battery jars were used as rearing cages. In all cases peach foliage was used as food for the larvæ. There is one full brood and a partial second brood.

The rearing studies began with the collection of a quantity of larvæ September 3, 1914. These overwintered, and the moths which emerged were used for part of the 1915 records. The rearing material for 1916 was that kept from the season of 1915, together with moths emerging from pupæ collected in May, 1916.

EMERGENCE OF SPRING BROOD OF MOTHS, 1916.

The earliest emergence of moths took place on May 22 and beginning on June 5 was quite regular until July 14, with the maximum emergence on June 29.

TABLE I.—*Emergence of spring brood of moths of the striped peach worm in 1916.*

Date of observation.	Number of moths.	Date of observation.	Number of moths.	Date of observation.	Number of moths.	Date of observation.	Number of moths.
May 22	1	June 13	12	June 29	60	July 13	3
May 30	2	June 15	30	July 2	32	July 14	3
June 5	1	June 17	24	July 4	14		
June 6	4	June 18	21	July 5	3	Total	364
June 8	5	June 21	56	July 7	18		
June 10	6	June 23	43	July 10	4		
June 11	3	June 25	17	July 12	2		

OVIPOSITION OF SPRING BROOD OF MOTHS.

As the moths emerged they were placed in jars with peach foliage and fruit. The moths oviposited freely in confinement whenever fruit was supplied in the oviposition jars. The eggs were deposited both on the fruit (Pl. II, fig. 2) and under the scales surrounding the attachment of the peach to the stem. In a single instance one egg was found in the axil of a peach leaf. On the sand cherry the eggs were found under the bud scales at the base of the current season's growth and in the axils of the leaves as indicated by the circles shown in Plate IV, figure 1, *a*. The occurrence of the eggs on the peach under orchard conditions was not noted. From Table III it will be seen that in 1915 eggs were being deposited in the jars from June 2 until June 26.

LENGTH OF LIFE OF MOTHS OF SPRING BROOD.

The length of life of 20 adults which were provided with a weak solution of clarified honey for food is shown in Table II.

TABLE II.—*Length of life of 20 moths of the spring brood of the striped peach worm, 1916.*

Number of moths.	Days of life.	Number of moths.	Days of life.
1	4	3	14
5	6	1	16
5	9	1	28
4	12		
		20	

Maximum length of life	days	28
Minimum length of life	do	4
Average length of life	do	10.6

The average length of life of the adults is seen to be 10.6 days. From observations made in 1915, however, one adult was found to live 31 days, and eight moths emerging previous to May 24 were alive a month later. These moths were not supplied with food.

HABITS OF THE MOTHS.

The adults are not often seen in the field because of their small size and inconspicuous coloring. They are difficult to follow when seen because of their habit of short irregular flights and their resemblance when at rest to the color of the twigs of the host plant. The characteristic resting position is shown in Plate III, figure 3, from a photograph of a live specimen. One pair of adults was observed in copulation in a rearing cage on June 21, 1916, at 10.30 a. m. The heads of the male and female were in opposite directions and no parts were in contact except the genital organs. Both moths remained quiet during copulation.

FIRST BROOD.

INCUBATION.

In Table III the incubation period for the eggs deposited each day is shown. It will be seen that there was a variation of from 10 to 19 days in the incubation period, and even with eggs deposited the same day on the same fruit and thus subjected to the same external conditions there was a variation of five days. The average length of the incubation period was 13.18 days.

TABLE III.—*Incubation period of first-brood eggs of the striped peach worm at Benton Harbor, Mich., 1915.*

Date of oviposition.	Number of eggs deposited.	Date of hatching.	Number of larvæ.	Egg stage.	Date of oviposition.	Number of eggs deposited.	Date of hatching.	Number of larvæ.	Egg stage.
				Days.					*Days.*
June 2...	11	June 15..	11	13			June 26..	2	10
		June 16..	1	13	June 16..	6	June 27..	2	11
June 3...	6	June 19..	2	14			June 28..	1	12
		June 20..	1	15			June 28..	10	10
June 5...	4	June 21..	3	16	June 18..	29	June 29..	13	11
		June 20..	23	14			June 30..	5	12
June 6...	28	June 23..	1	17			July 1...	1	13
		June 24..	3	18	June 20..	4	June 30..	2	10
		June 25..	1	19	June 26..	5	July 7...	1	11
June 10..	2	June 23..	2	13					
June 12..	20	June 26..	20	14	Total..	118	.....	107	.....
June 12..	3	June 27..	2	15					

Maximum egg stage.....days.. 19
Minimum egg stage.....do.... 10
Average egg stage.....do.... 13.18

Feeding Period of First-Brood Larvæ.

The feeding period of the larvæ in the rearing cages in 1915 extended from June 15 to August 5. In 1916, larvæ were feeding from June 22 until August 1 as shown in Tables IV and V. The longest feeding period recorded was 48 days, the shortest 22 days, and the average 29.6 days for transforming larvæ, and 34.2 days for overwintering larvæ. On July 28, 1915, the writer came upon the injury on sand cherry. The infestation was at its height and practically all the insects in the larva stage. By August 11 about one-half the larvæ had left the webs and newly formed pupæ were to be found in the soil. Observations made on September 14 showed that from 95 to 98 per cent of the larvæ had left the webs.

Table IV.—*Length of feeding period of transforming first-brood larvæ of the striped peach worm, 1916.*

Date of hatching.	Date of cocooning.	Number of cocoons.	Days of feeding.	Date of hatching.	Date of cocooning.	Number of cocoons.	Days of feeding.
June 22	July 20	1	28	June 25	July 17	2	22
Do	July 22	3	30	Do	July 20	2	25
Do	July 24	1	32	Do	July 26	1	31
Do	July 26	1	34				
Do	July 27	2	35	Total		14	
Do	July 28	1	36				

Maximum length of feeding period ..... days.. 36
Minimum length of feeding period ..... do.. 22
Average length of feeding period ..... do.. 29.6

Table V.—*Length of feeding period of wintering first-brood larvæ of the striped peach worm, 1916.*

Date of hatching.	Date of cocooning.	Number of cocoons.	Days of feeding.	Date of hatching.	Date of cocooning.	Number of cocoons.	Days of feeding.
June 22	July 20	2	28	June 22	Aug. 9	1	48
Do	July 23	1	31	June 25	July 17	1	22
Do	July 24	2	32	Do	July 26	3	31
Do	July 27	1	35	July 5	July 31	1	26
Do	July 28	4	36	Do	Aug. 1	1	27
Do	July 31	3	39				
Do	July 30	2	38	Total		23	
Do	Aug. 8	1	47				

Maximum length of feeding period ..... days.. 48
Minimum length of feeding period ..... do.. 22
Average length of feeding period ..... do.. 34.2

Cocooning of First Brood.

Cocooning takes places in the soil at an average depth of one-half inch, in fine sandy loam in the rearing cages, and this was found to be the usual depth in the soil in the field where the pupæ were found. Of a total of 203 individuals recorded, 31 pupated on the surface of the soil, 154 in the upper half inch, 18 in the second half inch,